

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

COVER CROP

(Ac.)

CODE 340

DEFINITION

Grasses, legumes, and forbs planted for seasonal vegetative cover.

PURPOSES

This practice may be applied for one or more of the following purposes:

1. To reduce erosion from wind and water;
2. To maintain or increase soil health and organic matter content;
3. To reduce water quality degradation by utilizing excess soil nutrients;
4. To suppress excessive weed pressures and break pest cycles;
5. To improve soil moisture use efficiency;
6. To minimize soil compaction.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies on all lands requiring seasonal vegetative cover for natural resource protection and/or improvement.

It is most often applied on cropland as part of a nutrient management plan where a cover crop is used to immobilize or remove excess soil nutrients, or on sloping land to protect the soil surface during the winter following a low residue crop. On relatively flat slopes, cover crops help with water infiltration, prevent wind erosion of soils, and add organic matter to soils. A cover

crop may also be used to provide temporary cover before establishing a permanent planting.

CRITERIA

Criteria Applicable to All Purposes

Plant Selection. Select a cover crop to accomplish the intended purpose of the practice and the objectives of the client. The species selected must be compatible with other components of the cropping system and the nutrient management and pest management plans, as applicable.

Cover crops may be established between successive production crops, companion-planted, or relay-planted (interplanted) into production crops. Select species and planting dates that will not compete with the production crop yield or harvest.

Ensure that herbicides used with production crops are compatible with cover crop selections and purpose(s).

Refer to Tables 1 and 2 for a listing of cover crops, seeding rates, seeding depths, planting dates, kill dates, and suitable uses. Select species based upon time of year, availability and cost of seed, and geographic location. Adjust the seeding rate as appropriate based on the method of planting and planting conditions.

Species planted cannot be invasive or noxious to Delaware.

When a cover crop will be grazed or hayed, ensure that crop selection(s) comply with pesticide label restrictions, and that the planned

management will not compromise the selected conservation purpose(s).

Do not harvest cover crops for seed or burn cover crop residue.

Site Preparation and Soil Amendments. Site preparation for planting on a conventional seedbed shall be done at a time and manner to ensure successful establishment of the cover crop. Seedbed preparation is not needed when using a no-till drill, and is not feasible when broadcasting or aerial seeding into a standing crop or crop residue.

Apply lime and fertilizer only if needed based on current soil test results. Any use of organic or inorganic fertilizer must be in compliance with Delaware nutrient management regulations, as applicable. (Delaware Department of Agriculture. Title 3 of Delaware Code, Chapter 22, Nutrient Management.) Exceptions to this are listed under “Additional Criteria to Capture and Recycle Excess Nutrients in the Soil Profile.”

Plant Establishment. For best results, use a planting method that incorporates the seed into the soil. Conventional drilling into a prepared seedbed, no-till drilling, or broadcasting followed by light soil incorporation (e.g., with a cultipacker, vertical tillage, rolling basket, or light disking) are preferred seeding methods because they optimize seed-soil contact.

Aerial seeding or broadcasting without incorporation may be used, but these methods require higher seeding rates to compensate for poorer seed distribution and/or germination.

Plant cover crops as early as feasible within the time period indicated in Tables 1 and 2. This may be immediately after harvesting the previous crop, or in the case of a late harvest, it may require overseeding before harvest. When planting near the end of the growing season, select a cover crop that will germinate and grow rapidly to help assure a successful stand.

Inoculate legume seeds with the proper, viable *Rhizobium* bacteria before planting. Keep inoculant as cool as possible before use and do not use it later than the date indicated on the package.

Plant cover crops as early as possible and terminate as late as feasible to maximize plant biomass and nutrient uptake, considering crop insurance criteria, the time needed to prepare the field for the following crop, and soil moisture depletion.

Termination of Cover Crops. Seasonal cover crops shall be terminated by harvest, frost, mowing, rolling/crimping, tillage, and/or herbicides in preparation for the next crop. Herbicides used with cover crops shall be compatible with the following crop.

The cover crop can be killed at various growth stages, depending on the purpose of the practice, the crop rotation, and weather. Do not burn cover crop residue.

To meet crop insurance requirements for a following crop on non-irrigated cropland, cover crops must be terminated by the time of planting or within 5 days after planting the following crop, but before crop emergence. Refer to NRCS Cover Crop Termination Guidelines – Non-Irrigated Cropland. Based on the planned purpose of the cover crop, it can be terminated earlier than stated in these guidelines.

Additional Criteria to Reduce Erosion from Wind and Water

Time the cover crop establishment in conjunction with other practices to adequately protect the soil during the critical erosion period(s).

Select cover crops that have the physical characteristics necessary to provide adequate erosion protection.

Use the current erosion prediction technology to determine the amount of surface and/or canopy cover needed from the cover crop to achieve the erosion objective. Refer to http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm

Additional Criteria to Maintain or Increase Soil Health and Organic Matter Content

Select cover crop species on the basis of producing high volumes of organic material and/or root mass to maintain or increase soil organic matter.

The planned crop rotation, including the cover crop and associated management activities, will score a Soil Conditioning Index (SCI) value > 0 , as determined using the current approved NRCS Soil Conditioning Index (SCI) procedure, with appropriate adjustments for additions to and/or subtractions from plant biomass. The SCI is contained in RUSLE2.

Additional Criteria to Reduce Water Quality Degradation by Utilizing Excess Soil Nutrients

Establish cover crops as soon as practical prior to or after harvest of the production crop. Cover crops shall be established and actively growing before the expected period(s) of nutrient leaching.

Select cover crop species for their ability to take up large amounts of nutrients from the rooting profile of the soil. If the cover crop will be harvested for forage (e.g., hay, balage, etc.), choose species that are suitable for the planned livestock and capable of removing the excess nutrients.

No fall application of manure is allowed prior to planting the cover crop. In limited circumstances and when approved by a nutrient management consultant, 20 to 30 lbs. of starter N can be applied prior to planting. In situations where there is limited available N due to excessive rainfall or high yields utilizing irrigation, starter N can be applied so the cover crop can develop a stronger root system that can scavenge N from deeper in the soil profile. No phosphorus can be applied.

No winter application of commercial fertilizer or manure is allowed. Spring application of manure can resume after March 1st in Sussex County and March 15th in Kent and New Castle Counties.

Cover crops cannot be destroyed until after March 15th. If spring peas are being planted, the cover crop can be destroyed after March 1st.

When used to redistribute nutrients from deeper in the profile up to the surface layer, the cover crop will be killed in relation to the planting date of the following crop. If the objective of the cover crop is a green manure to cycle nutrients, an early kill will have a lower carbon/nitrogen

ratio for a faster mineralization of nutrients for uptake by the following crop.

Additional Criteria to Suppress Excessive Weed Pressure and Break Pest Cycles

Select cover crop species for their life cycles, growth habits, and other biological, chemical, and or physical characteristics to suppress weeds or compete with weeds; to break pest life cycles or suppress plant pests or pathogens; to provide food or habitat for natural enemies of pests; and/or to release chemicals such as glucosinolates that suppress soil borne pathogens or pests.

Select cover crop species that do not harbor pests or diseases of subsequent crops in the rotation.

Leave cover crop residues on the soil surface to maximize alleopathic (chemical) and mulching (physical) effects. A late kill may be used if the objective is the use of a bio-control.

For long-term weed suppression, summer annual cover crops or reseeding annuals and/or biennial species can be used.

Additional Criteria to Improve Soil Moisture Use Efficiency

Terminate growth of the cover crop sufficiently early to conserve soil moisture for the subsequent crop. Cover crops established for moisture conservation shall be left on the soil surface.

On soils with excess soil moisture, allow the cover crop to grow as long as possible to maximize soil moisture removal.

Additional Criteria to Minimize Soil Compaction

Select and manage cover crop species that will produce deep roots and large amounts of surface or root biomass to decrease compaction, increase soil organic matter, improve soil structure, and increase soil moisture through better infiltration.

Note: Specific programs or other funding sources may dictate criteria in addition to, or more restrictive than, those specified in this standard.

CONSIDERATIONS

General Considerations

For seasonal cover crops, consider the use of annual grasses, including cereal grains. These plants provide satisfactory results at a reasonable cost. In the summer, a warm-season annual grass (such as foxtail millet or pearl millet) can be used as a “half-season” cover crop after an early vegetable crop, before a late crop, and to control weeds while land is out of production for a short period of time.

Cover crops may be selected to provide food or habitat for natural enemies of production crop pests. Also consider plant species that enhance forage opportunities for pollinators by using diverse legumes and other forbs.

Consider that plant disease and insect problems can be increased by the use of cover crops. The principle of good rotation, in which grasses are alternated with legume crops, should help to avoid this problem. For example, corn or wheat should follow legume cover crops, while soybeans are better following small grains.

Avoid cover crop species that attract potentially damaging insects and other crop pests. If using cereal grains as cover crops, consider the need for pest management of Hessian fly, powdery mildew, and other pests common to these crops. Cover crops that can harbor pests or crop pathogens for the following crop should not be grown just before or adjacent to susceptible crops.

Some cover crops may present a weed problem by volunteer seeding when or where they are not wanted. The vetches and annual ryegrass have this tendency. It is usually not a serious problem and in most cases can be handled through normal weed control practices.

Consider whether the cover crop will be planted before or after harvesting a standing crop. If broadcast overseeding will be used, consider species that are suitable for this planting method. Overseeding allows the cover crop to get a head start and provides soil coverage when the primary crop is harvested. Winter rye, annual ryegrass, hairy vetch, and various clovers can be

overseeded into wide-row crops before harvesting the primary crop.

If a cover crop will be planted late in the growing season, consider the amount of time needed for germination and sufficient growth before dormancy. Annuals generally germinate more rapidly than perennials, and grasses usually germinate more rapidly than legumes. Rapidly establishing cool-season grass species include annual ryegrass and spring oats, followed by winter rye and wheat. Buckwheat, foxtail millet, pearl millet, and sudangrass are rapidly establishing warm-season species. Warm season annuals should not be planted in the fall because soil temperatures below 65 degrees will inhibit germination, and the plants will be killed by frost.

Additional Considerations for Termination of Cover Crops

Consider the appropriate timing for killing the cover crop. Practical considerations for termination include crop insurance criteria, the amount of time needed to prepare the field for planting the next crop, weather conditions, and cover crop effects on soil moisture and nutrient availability to the following crop.

Time the termination of cover crops to meet nutrient release goals. Termination at early vegetative stages may cause a more rapid release compared to termination at a more mature stage. Both residue decomposition rates and soil fertility can affect nutrient availability following termination of cover crops. Legumes add the most plant-available N if terminated when about 30% of the crop is in bloom.

In most years, the cover crop should be terminated as late as feasible to maximize plant growth but allow sufficient time to prepare the seedbed for the next crop. Killing cover crops early is important when winter and early spring rainfall is lower than normal, which will conserve soil moisture.

If wet weather delays termination in the spring, too much top growth may be produced by the cover crop. This is more likely to be a problem with crops such as rye that tend to start growth early in the spring and grow quickly. In addition, if heavy cover crops are plowed down in cool,

wet conditions, they may release toxins or tie up nutrients as they decompose. Under these conditions, more time will be needed for decomposition to take place before planting the next crop.

Consider whether cover crop residues may interfere with seedbed preparation for the next crop, temporarily tie-up nitrogen that is needed by the next crop, or reduce seed germination by allelopathy.

Additional Considerations to Reduce Water Quality Degradation by Utilizing Excess Soil Nutrients

If residual nutrients in the soil are a concern, consider species that will provide sufficient uptake of the target nutrients. Grasses utilize more soil nitrogen than legumes, and legumes utilize both nitrogen and phosphorus. Deep-rooted species provide maximum nutrient uptake.

Winter annual grasses, especially cereal grains, can immobilize significant quantities of residual nitrogen left from the previous crop and can reduce the potential for nitrate leaching to the groundwater. The efficiency of these grasses for using residual nitrogen in the fall is (in decreasing order): rye, wheat, barley, and oats. The earlier the planting in the fall, the more growth and nutrient uptake will occur before winter dormancy.

When appropriate for the crop production system, consider mowing certain grass cover crops (e.g., sorghum-sudangrass, pearl millet) prior to heading, and allowing the cover crop to regrow. This can enhance rooting depth and density, thereby increasing nutrient-recycling efficacy.

Additional Considerations to Maintain or Increase Soil Health and Organic Matter Content

All cover crops can provide nutrients and organic matter to the soil. Cereal grains, annual ryegrass, millet, sudangrass, and sorghum-sudangrass hybrids serve as good green manure crops.

Increasing the diversity of cover crops (e.g., by using mixtures of several plant species and varying functional groups) can promote a wider

diversity of soil organisms, and thereby promote increased soil health and organic matter.

Grasses generally produce more dry matter than legumes, but they also decompose more slowly and are less efficient in conserving soil moisture. Grass/legume mixtures produce more dry matter, provide better early ground cover, and additional mulch for soil moisture conservation than either component grown alone.

Planting legumes or mixtures of legumes with grasses, crucifers, and/or other forbs can provide nitrogen through biological nitrogen fixation.

Consider the use of winter annual legumes to provide nitrogen for a succeeding summer crop. Their use can reduce purchased fertilizer inputs. Three winter annual legume crops that provide significant amounts of nitrogen for the next crop are (in decreasing order): hairy vetch, Austrian winter peas, and crimson clover. Other legumes may be used, but most supply smaller quantities of nitrogen.

While legumes can supply large amounts of nitrogen to the summer crop, they provide minimum protection for nitrate leaching from the root zone when compared to cereal grains and other grasses. The level of protection can be enhanced by planting the legume along with a fibrous rooted (grasses) or deep rooted (some forbs) crop.

Consider C:N ratio of crop residues of previous crops and planned cover crops. The faster crop residues are consumed by soil microorganisms the less time those residues will be covering the soil surface. Crop residues on the soil surface are important for protecting soil aggregates from the destructive force of raindrops hitting the soil, conserving soil moisture, and providing habitat for arthropods that shred crop residue and eat weed seeds. It is also essential that those same residues decompose to release plant nutrients and build soil organic matter. It is important to pay attention to crop residue C:N ratios to maintain soil cover when desired, yet allow the residues to break down and be recycled.

Biennial and perennial legumes, although useful for supplying nitrogen and providing ground cover protection for the soil, are best suited as permanent pasture and hay crops in long-term

rotations and should not be planted and utilized as annual cover crops.

PLANS AND SPECIFICATIONS

Plans and specifications for this practice shall be prepared in accordance with the previously listed criteria. Plans and specifications shall contain sufficient detail to ensure successful implementation of this practice, and may be recorded in narrative form on Implementation Requirements (IR) worksheets, fact sheets, or other approved forms.

The appropriate fact sheet(s) and completed 340 IR worksheet can serve as the plan and specifications for this practice. Specify the following for each cover crop:

1. Purpose of the planting;
2. Field number and acres;
3. Species to be planted, seeding rates, and recommended seeding dates;
4. Seeding method (e.g., drilled, broadcast with incorporation, broadcast without incorporation, aerial);
5. Planned rates and timing of nutrient application, if applicable;
6. Planned dates and methods of cover crop termination;
7. Other information pertinent to establishing and managing the cover crop.

OPERATION AND MAINTENANCE

An Operation and Management (O&M) plan shall be prepared and is the responsibility of the client to implement. The appropriate fact sheet(s) and IR worksheet may serve as the management plan, as well as supporting documentation, and shall be reviewed with and provided to the client.

At a minimum, the following components shall be addressed in the O&M plan, as applicable:

1. Establish the cover crop within the stated time period and maintain until the stated time/growth stage. Evaluate the cover crop to

determine if it is meeting the planned purpose(s). If the cover crop is not meeting the purpose(s), adjust the management, change the species of cover crop, or choose a different technology;

2. Control weeds as needed by mowing or by spraying with an appropriate herbicide. Noxious weeds must be controlled as required by state law;
3. If forage use is desired, green-chop or graze the cover crop in the late boot to early head stages when optimal nutritional content and yield is available;
4. Unless the cover crop will be used for supplemental forage, kill a grass cover crop no later than the late joint to early boot stage, or no later than 2 to 4 weeks before planting the next crop. This timing of the kill date permits maximum growth and uptake of residual nutrients by the cover crop, while allowing sufficient time for the decomposition of the vegetation, release of nutrients, and recharge of soil moisture. Legumes killed while succulent decompose more rapidly than grasses, so killing a legume cover crop 1 to 2 weeks before planting the next crop is usually sufficient;
5. Describe the acceptable uses (e.g., green manure crop, green-chop, grazing) and time of year or frequency of use restrictions, if any. *Pay particular attention to program requirements as they relate to acceptable vs. restricted uses and other management restrictions.*

SUPPORTING DATA AND DOCUMENTATION

The following is a list of the minimum data and documentation to be recorded in the case file:

1. Location of the practice on the conservation plan map;
2. Assistance notes. The notes shall include dates of site visits, name or initials of the person who made the visit, specifics as to alternatives discussed, decisions made, and by whom;

3. Soil loss calculations (RUSLE2 printouts), if erosion control is a purpose;
4. Soil Conditioning Index (SCI) value, if soil health or organic matter is a purpose;
5. Completed IR worksheet, and copy of the appropriate fact sheet(s) or other specifications and management plans.

REFERENCES

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FIGURE 1: USDA Plant Hardiness Zones for Delaware



TABLE 1: RECOMMENDED COVER CROPS											
Species	Seeding Rate (lbs/ac) ^{1/}	Seeding Depth (inches) ^{2/}	Suitable Uses ^{3/}						Planting dates based on PHZ ^{4/}	Kill /Suppression Dates ^{5/}	
			E	R	N	O	B	S			W
WINTER ANNUAL GRASSES											
Annual Ryegrass <i>Lolium multiflorum</i> Lam.	20 (15-50)	0.25 - 0.5	●	●		●		●	●	9/1 - 11/15	For optimum benefits as a green manure crop, terminate no later than 2 to 4 weeks before planting the next crop. Spring oats may winter kill. To meet crop insurance requirements for a following crop on non-irrigated cropland, cover crops must be terminated by the time of planting or within 5 days after planting the following crop, but before crop emergence. Earlier termination is acceptable. NOTE – Planting before the Hessian Fly Free Dates (Oct 3 – New Castle County; Oct 8 – Kent County; Oct 10 – Sussex County) could result in damage from this pest in wheat, barley, triticale and rye. Oats are not attacked by Hessian Fly.
Spring Oats <i>Avena sativa</i>	95 (60-125)	1.0 - 1.5	●	●		●		●	●	9/1 - 10/15	
Winter Barley <i>Hordeum vulgare</i>	120 (90-150)	1.0 - 1.5	●	●		●		●	●	9/1 - 11/1	
Winter (Cereal) Rye <i>Secale cereale</i>	120 (90-150)	1.0 - 1.5	●	●		●		●	●	9/1 - 11/15	
Winter Wheat <i>Triticum aestivum</i>	120 (90-150)	1.0 - 1.5	●	●		●		●	●	9/1 - 11/15	
Triticale <i>Triticum X Secale</i>	105 (90-120)	1.0 - 1.5	●	●		●		●	●	9/1 - 11/15	
WINTER ANNUAL LEGUMES											
Austrian Winter Pea <i>Pisum sativum</i>	80 (60-100)	1.0 - 1.5	●		●	●	●	●		9/1 - 10/15	For optimum benefits as a green manure crop, terminate no later than 2 to 4 weeks before planting the next crop. To meet crop insurance requirements for a following crop on non-irrigated cropland, cover crops must be terminated by the time of planting or within 5 days after planting the following crop, but before crop emergence. Earlier termination is acceptable. <u>Seeding rates for pre-inoculated and/or lime-coated seeds are PLS.</u> ^{7/}
Common Vetch <i>Vicia sativa</i>	60 (25-90)	0.5 - 1.0	●		●	●	●	●		9/1 - 10/15	
Hairy Vetch <i>Vicia villosa</i>	25 (15-25)	0.5 - 1.0	●		●	●	●	●	●	9/1 - 10/15	
Crimson Clover <i>Trifolium incarnatum</i>	20 (10-20)	0.25 - 0.5	●		●	●	●	●		9/1 - 10/15	

TABLE 1: RECOMMENDED COVER CROPS

Species	Seeding Rate (lbs/ac) ^{1/}	Seeding Depth (inches) ^{2/}	Suitable Uses ^{3/}							Planting Dates by PHZ ^{4/}	Kill/Suppression Dates ^{5/} and Other Notes
			E	R	N	O	B	S	W		
WINTER ANNUAL BRASSICAS ^{6/}											
Kale <i>Brassica oleracea</i>	8 (5-12)	0.25 - 0.5	●	●		●		●	●	9/1 - 10/15	If grown on sandy soils, extra sulfate sulfur may be needed for improved growth. Kill prior to seed heads maturing.
Winter Rape (Canola) <i>Brassica napus</i>	8 (5-12)	0.25 - 0.5	●	●		●		●	●	9/1 - 10/15 See Other Notes	If grown on sandy soils, extra sulfate sulfur may be needed for improved growth. If the purpose is nematicide, plant before Sept. 20 th . Kill prior to seed heads maturing.
Forage/Oilseed Radishes <i>Raphanus sativus</i> var. <i>niger</i> , var. <i>oleiferus</i> , and var. <i>longipinnatus</i>	10 (8-14)	0.25 - 0.5	●	●		●		●	●	9/1 - 10/15	<u>Seeding rates for these species are PLS. ^{7/}</u> May be planted up to an inch deep during dry conditions. The varieties 'niger' and 'longipinnatus' have very long, thick tap roots. These varieties are sometimes referred to as "tillage" radishes because they can be used to break up hard pans. The variety 'oleiferus' (usually grown for oilseed) has shorter roots but is somewhat more winter hardy.
Forage Turnip <i>Brassica rapa</i>	4-7	0.5	●	●		●		●	●	9/1 - 10/15	<u>Seeding rates for these species are PLS. ^{7/}</u> If grown on sandy soils, extra sulfate sulfur may be needed for improved growth.
SUMMER ANNUAL GRASSES											
Sudangrass <i>Sorghum bicolor</i> var. <i>sudanese</i>	30 (20-40)	0.5 - 1.0	●			●		●	●	5/1 - 6/15	
Sorghum - Sudangrass Hybrids <i>Sorghum bicolor</i> X <i>S. bicolor</i> var. <i>sudanese</i>	25 (20-30)	0.5 - 1.0	●			●		●	●	5/1 - 6/15	
Pearl Millet <i>Pennisetum glaucum</i>	20 (15-20)	0.5 - 1.0	●			●		●	●	5/15 - 7/1	
Foxtail (German) Millet <i>Setaria italica</i>	25 (20-30)	0.5 - 1.0	●			●		●	●	5/15 - 7/1	
Teff <i>Eragrostis tef</i>	5 (4-6)	0.125 - 0.25	●			●		●	●	5/15 - 7/1	

TABLE 1: RECOMMENDED COVER CROPS

Species	Seeding Rate (lbs/ac) ^{1/}	Seeding Depth (inches) ^{2/}	Suitable Uses ^{3/}							Planting Dates by PHZ ^{4/}	Kill/Suppression Dates ^{5/} and Other Notes	
			E	R	N	O	B	S	W			
<i>SUMMER ANNUAL FORAGES & LEGUMES</i>												
Buckwheat <i>Fagopyrum esculentum</i>	80 (40-120)	0.5 - 1.0	●	●		●			●	●	5/15-8/1	For optimum benefits as a green manure crop, terminate no later than 1 to 2 weeks before planting the next crop. To meet crop insurance requirements for a following crop on non-irrigated cropland, cover crops must be terminated by the time of planting or within 5 days after planting the following crop, but before crop emergence. Earlier termination is acceptable.
Annual Lespedeza: Korean <i>Kummerowia stipulacea</i> <u>or</u> Common <i>K. striata</i>	15 (12-20)	0.25 - 0.5	●		●	●					3/20-4/15	
Soybeans <i>Glycine max</i>	105 (90-120)	1.0 - 1.5			●	●				●	5/15-7/1	

Additional Notes for this table are located on Page 13.

TABLE 2: RECOMMENDED COVER CROP MIXES

WINTER ANNUAL GRASS/LEGUME/BRASSICA MIXTURES														
<i>*Select one GRASS, one LEGUME, and one BRASSICA; or one GRASS and one LEGUME; or one GRASS and one BRASSICA (total seeding rate is the sum of the individual species)</i>														
Species	Seeding Rate (lbs/ac) ^{1/}		Seeding Depth (inches) ^{2/}	Suitable Uses ^{3/}						Planting dates based on PHZ ^{4/} 7a - 7b	Kill /Suppression Dates ^{5/} and Other Notes			
	Drilled	Broadcast		E	R	N	O	B	S			W		
<i>*Select one GRASS</i>														
Rye, Wheat, Barley Triticale <i>Secale cereale, Triticum aestivum, Hordeum vulgare, Triticum x Secale</i> , respectively	35-45	45-55	0.25 – 0.5	●	●		●	●	●	●	9/1 - 10/15	<p>For optimum benefits as a green manure crop, terminate no later than 1 to 2 weeks before planting the next crop. To meet crop insurance requirements for a following crop on non-irrigated cropland, cover crops must be terminated by the time of planting or within 5 days after planting the following crop, but before crop emergence. Earlier termination is acceptable.</p> <p>These cover crops may entirely winter kill, depending on geographic location and/or the severity of the winter.</p> <p>When using Annual Ryegrass in the mixture, plant to a depth of 0.5 inches.</p> <p>Research suggests Hairy Vetch is a better phosphorus scavenger than other legumes.</p> <p><u>Legumes seeding rates are based on PLS.^{7/}</u></p> <p>Brassicas: lower rates work well if planted early (mid-Aug. to early Sept.). Higher rates may be needed if planted later (mid-Sept. – Oct.). Tillage radish (<i>Raphanus sativus</i> var. <i>niger</i>, or var. <i>longipinnatus</i>) is an excellent choice for reduction of soil compaction.</p> <p><u>Brassica/Raphanus seeding rates are based on PLS.^{7/}</u></p>		
Spring Oats <i>Avena sativa</i>	50-55	55-60		●	●		●	●	●	●				
Annual Ryegrass <i>Lolium perenne</i> ssp. <i>multiflorum</i>	15	20		●	●		●	●	●	●				
<i>*Select one LEGUME</i>														
Hairy Vetch <i>Vicia villosa</i>	15-20	25-30		●		●	●	●	●	●				
Crimson Clover <i>Trifolium incarnatum</i>	8-12	15-20		●		●	●	●	●	●				
<i>*Select one BRASSICA</i>														
Forage/Oilseed Radishes <i>Raphanus sativus</i> var. <i>niger</i> , var. <i>oleiferus</i> , and var. <i>longipinnatus</i>	2	3-4	●	●		●	●	●	●					
Winter Rape (Canola), Kale, Turnips <i>Brassica napus, B. rapa, B. oleracea</i>	2	3-4	●				●	●	●					

Additional Notes for this table are located on Page 13.

NOTES FOR TABLES 1 AND 2:

¹ **Seeding Rate:** Seeding rates listed are for planting methods that incorporate seed into the soil. These methods include drilling (conventional or no-till) and broadcast seeding followed by light soil incorporation with a cultipacker, vertical tillage, rolling basket, or light disking. **A minimum germination rate of 80% is required unless using PLS.**

If broad cast seeding (without incorporation) or aerial seeding, increase the primary seeding rate (Table 1) or broadcast seeding rate (Table 2) by at least 30%. When calculating a 30% increase, use 1.3 x the primary seeding rate per individual species.

For Table 1- A primary seeding rate and a seeding range (in parentheses) is provided. Use the primary seeding rate for broadcasting/incorporating with average planting conditions (e.g., considering soil moisture, temperature, timing of rainfall, planting date, etc.). Use the rate at the low end of the range when planting conditions are optimal or when a drill is used. When conditions are less than optimal or when planting late in the season, use the rate at the high end of the range.

² **Seeding Depth:** Provides the recommended depth to plant seed to obtain the best germination. Plant deeper in sandy soil, and less deep in clayey soil.

³ **Suitable Uses:** Lists the benefits obtained from each species or mix:

E - Erosion control and surface water protection; R - Recycle excess nutrients; N - Nitrogen fixation; O - Organic matter added; B - Biodiversity; S - Soil structure improved; W - Weed suppression.

⁴ **Planting Dates:** Preferred planting dates are listed based on Plant Hardiness Zones (see Figure 1). Successful establishment of the planting will vary with environmental conditions, but is more likely to occur if the crop is planted near the beginning of the planting period. Planting before the earliest date is permissible when weather conditions are favorable. To allow sufficient time for growth, the latest planting date should rarely be exceeded.

⁵ **Kill/Suppression Dates:** The preferred timing for killing the cover crop or suppressing growth of the crop. Harvesting or herbicide treatment may be used, or the crop may be rolled/crimped or plowed under, depending on the purpose and desired use of the cover crop.

⁶ **"Brassica" cover crops** (family Brassicaceae) include rape, kale, mustard, turnips, etc. Canola is a term for rape cultivars that are used to produce oil and other products for human and livestock consumption. Oil from other rape varieties is less palatable and is used for industrial purposes. All rape varieties are suitable for use as cover crops.

Brassicas can be especially useful for planting after early vegetable crops. Brassica cover crops are well-suited for uptake of residual nitrogen in the fall because they grow rapidly during periods of cool weather. They may also provide other benefits such as suppression of detrimental nematodes, plant diseases, weeds, and reduce soil compaction.

There are a few drawbacks to using Brassica cover crops: (1) Brassicas have low tolerance for poorly drained or frequently flooded soils; (2) Plants are susceptible to below freezing temperatures, and may winter-kill. It is important that they be well-established (6 to 8 leaf stage) before a hard freeze in order to provide the benefits of a cover crop; (3) If allowed to set seed, these plants may become "weedy" in crop fields.

⁷ **Pure Live Seed (PLS):** Percent (%) Purity x Percent (%) Total Germination /100 = % PLS